Gaianews.it

Quasars to fill a gap of Bell's theorem

Written by Annalisa Arci on 02/21/2014

In a *paper* published this week in the journal *Physical Review Letters,* the MIT researchers propose an experiment that could fill one of the most significant gaps concerning the **equality of dis Bell** proposed a theorem about fifty years ago that, if it were filled, would deliver the our universe in the hands of the probabilities of quantum mechanics.

This vision would confirm the quantum *entangled* particles can influence each other instantaneously, at a speed much higher than the speed of light. Bell's theorem shows that, if quantum mechanics is valid then the measurements performed on the two particles are always correlated, regardless of the distance that separates them.

Artistic representation of ULAS J1120 +0641, a very distant quasar. (Credit: ESO / M. Kornmesser).

A magical correlation. Take two subatomic particles. They have a spin, that rotate on their own axis, just like the spinners or planets. Imagine that you have a system with two particles very close to that rotate in opposite directions: it commonly describes this situation by saying that the spin of a particle is up (up) and that of the other is down (down). By measuring the spins of the particles after they have been substantially removed, we find that have remained one up and the other down. Since that behave like small magnets, it is possible to change orientation by passing through magnetic fields: if we change the orientation of a particle so that, instead of rotating upward around a vertical axis, rotates to the left around a horizontal axis, we find that also the other particle rotates around a horizontal axis, but in the opposite direction, which will define the right.

These results were confirmed initially by two experiments, the first performed in 1972 by J. Clauser and S. Freeman in the United States, and the second by A. Aspect, P. Grangier and Roger C. at CERN in 1981. Consequently, as it may seem unusual, there is some form of instant communication between the two particles such that, by changing the spin of a, wetsuit instantly the spin of the other. Snapshot in physical terms means superluminare speed that is greater than the speed of light.

In 1964 **John Bell** summed up the apparent disparity between classical physics and quantum mechanics stating that if the universe is explained by classical physics, the measurement of a particle *entangled* shall not affect the determination of the other particle - a theory known as the principle of **locality,** which puts a limit to the correlation. Bell has developed a mathematical formula for the town, and presented scenarios that violate this formula according to the predictions of quantum mechanics. Einstein would be appalled, but experiments confirm that if one of the two entangled particles is conducted a status, depending on the particle that is traveling at the speed of light in a direction opposite to the first is inexplicably also altered due to the change in the tax first particle.

The speed of light is an absolute value, a universal constant irrefutable that can not be denied: so how is it possible that a particle alters the status of the other when a communication between the two is, in principle, impossible? Physicists have repeatedly tested Bell's theorem by measuring the properties of entangled quantum particles in the laboratory, showing that Bell is right: if some subatomic particles are entangled, they retain an affinity permanent somehow seems to transcend the limitations of classical physics . There was no lack of course who has highlighted the shortcomings of the work of Bell. Proponents of hidden variables leverage on this topic to show that the quantum explanation is just an illusion. Making explicit the hidden variables in each explanation, here is apparent that the explanatory classical counterpart.

Although many gaps are now part of the history of physics, there remains a problem that has to do with **free will:** in an experimental context imaginary, the authors of the study that we present have imagined that there is an air conditioning system that has an effect on the measurements in the laboratory. In practice, it is as if the system of detectors conspired with shared causal events of the past to determine which values of the properties of the particles are measured - a scenario that, however far-fetched, it implies that a physicist who runs the experiment does not have free will in choosing the setting of each detector. Such a scenario would result in partial measures, suggesting that the two particles are more closely related than they really are, and giving more weight to the quantum mechanics of classical physics.

"It looks scary, but we realized that this is a logical possibility that has not yet been closed," said David Kaiser at MIT who, along with Andrew Friedman (postdoc at MIT) and Jason Gallicchio (University of Chicago) has proposed a experiment to close this gap by setting the third settings of a particle detector through a part of the universe's oldest light: that of distant quasars or active galactic nuclei, which was emitted billions of years ago.

The experiment with the quasar as photon detectors. If two quasars are located on opposite sides of the universe, the distance between them must be such as to make it independent of the causal chain that began with the Big Bang (about 14 billion years ago). This also means that, at the time, were not able to communicate with each other (an ideal scenario to determine the settings on each particle detector). The description of the experiment is very complex and you will not summarize it (for details refer to the original article). Instead try to simplify so that you understand the idea. Think of having two detectors and a particle generator, such as a radioactive atom which spits out pairs of entangled particles. At the detector must measure the first particle of the pair C and the detector B measures the second. To set the settings of the two detectors are called into question the two distant quasars that - according to the authors of the article - have never had causal connections nor retain, of course, no memory.

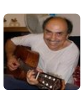
The reasoning of the researchers at this point is the following: Since the setting of each detector is determined from sources that have not had any communication or shared history since the beginning of the universe, it would be virtually impossible for these detectors "conspiring" with any thing in their common past. In this case the experimental set-up looks clean enough to fill the gap of "free will." If, after making several measurements with this experimental setup scientists were to discover that the particles are correlated more than expected by the laws of classical physics, then the universe as we see it really is based on quantum mechanics and classical physics.

I still have many doubts, but the authors of the paper argue that with current technology the experiment is feasible. All that remains is to wait for some lab experiment and put into practice give us a little more detail (possibly practical).

Paper reference:

Jason Gallicchio, Andrew S. Friedman, David I. Kaiser, *Testing Bell's inequality with photons cosmic: Closing the loophole setting-independence,* in "Physical Review Letters", 2014 (in press).

Tags: Quasar , Bell's Theorem



Alberto Zazza • 5 giorni fa

stato memoria preoccupante quantomeno impossibile.